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Results indicate that a general attitude toward the organization, overall career satisfaction, is the best predictor of reenlistment intention. The effects of experienced job characteristics on career satisfaction are mediated by overall job satisfaction. Measures of job context such as pay, allowances, and living quarters, were generally related to satisfaction with duty station or directly related to career satisfaction.

Contrary to expectations, the highest correlations of the technology measures were with the measures of overall satisfaction rather than with experienced job characteristics. The correlations are low, probably because of the way in which data from two different sets were merged, but statistically significant. Relationships among some concepts in the literature on technology and job analysis are discussed.

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EXECUTIVE SUMMARY

This research studies the relationships between the technological characteristics of Navy jobs, psychological characteristics of the jobs and reenlistment intentions. Measurements were made of three dimensions of technology involving the nature of the raw material or input, the operations and equipment used to process the input, and the knowledge or skill required of the workers to perform their jobs. Psychological characteristics included job challenge, the extent to which workers feel personal responsibility for their work and the extent to which they can see that they have produced something of consequence. Measures of overall satisfaction included duty station, job, and career satisfaction measures. Analyses are described for a sample of 3,000 Navy enlisted men who have jobs in the Electrician's Mate, Engineman and Gunner's Mate ratings.

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Contrary to expectations, the highest correlations of the technology measures were with the measures of overall satisfaction rather than with experienced job characteristics. The correlations are low, probably because of the way in which data from two different sets were merged, but statistically significant. Relationships among some concepts in the literature on technology and job analysis are discussed.

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I. Introduction

Government, management and unions are increasingly directing their attention to improving the Quality of Work Life. This is true in both the civilian and military sectors (Umstot, 1980). In the Navy, the existence of the Human Resource Management Program, under the guidelines of the Human Goals Plan, attests to this concern.

Many efforts concerned with improving the quality of work have focused specifically on improving the jobs or tasks which individuals perform. It has been assumed that better designed jobs will lead to higher motivation, performance, satisfaction and improvement in other indicators of healthy organizations and workers.

Most of the change efforts concerned with the design of work have used either one of several job design theories or they have used sociotechnical system theory. All approaches, Rousseau (1977) has noted, emphasize six common job dimensions: variety of tasks performed and skills employed, responsibility for and control over the work process, completion of meaningful units of work, feedback, interpersonal interaction and learning. These six common job dimensions are themselves an elaboration of a set of five "core" job dimensions that form the basis for three critical psychological states that affect the level of job satisfaction and individual performance. Following a model proposed earlier by Hackman and Lawler (1971), Hackman and Oldham (1976, p. 256-257) suggested that "an individual experiences positive affect to the extent that he <u>learns</u> (knowledge of results) that he <u>personally</u> (experienced responsibility) has performed well on a task that he <u>cares about</u> (experienced meaningfulness)." They have reported data that substantially supported this proposition.

Despite the large amount of research which has been done on job design little is known about the effects of technology upon the characteristics of the job as experienced by the worker. There are a number of reasons to believe that technology--the mechanisms or process by which an organization turns out its product or services--has a significant influence over the nature of the tasks that are performed by workers and that as a result it can indirectly affect job satisfaction and worker retention. Technology seems to effect job design because, once developed, it demands that certain tasks be performed and this greatly limits opportunities for meaningful job designs.

Unfortunately, the number of studies that have sought to demonstrate linkages between organizational technologies and individual level outcomes is disappointingly small. In part, this is because the concept of organizational technology has yet to be defined with any satisfactory degree of clarity. As a result some of the studies that have used the concept at the individual level have used functional department or job title as a proxy measure of technology (Herman & Hulin, 1972). Other studies have been limited in their samples (e.g., Taylor, 1971) or have not addressed individual level outcomes (Lynch, 1974).

The bulk of the research conducted on technology has addressed its relationship to the structure of the organization rather than on the attitudes and behavior of workers. Support for effects of technology on structure has not been unequivocal; where some investigators have found significant associations others have found none. To some extent it is possible to attribute these conflicting results to systematic differences

among the samples of organizations studied and failures to examine curvilinear relations (Blau, et al., 1976). However, it is probably a difference in indicators used to measure this construct that is the most significant problem. Major differences exist in the operationalization of the concept: some indicators are highly job specific; others tap two or more constructs. Most disconcerting are the cases in which a set of indicators, though they tap only one dimension, are treated as if they encompass the entire concept of technology (Stanfield, 1976).

In light of this situation, it is particularly important to examine carefully the alternative operational definitions of technology that have been proposed, to select the most appropriate and to clarify their meaning. Following that, it will be possible to propose a set of measures which, if not exhaustive, at least are mutually exclusive and logically distinct.

Technology

Many early discussions of the concept treated technology as synonymous with automation or mechanization (Walker & Guest, 1952). Most of these early investigators (and many recent ones as well) also considered technology to be a property of the organization as a whole (Woodward, 1965). Typical of their definitions of technology is that of Harvey (1968), who proposed that "by organizational technology is meant the mechanisms or processes by which an organization turns out its product or service." Two major classification systems at the organizational level are those of Woodward (1958) and Thompson (1967). Both of these systems are unidimensional typologies. Woodward's system

of unit, batch, mass and continuous technologies was described by Starbuck (1965) as measuring continuity of production. Thompson's typology of long-linked, mediating and intensive technologies was also proposed as descriptive of the organization as a whole.

More recently, investigators have elaborated the definition of technology to include a more careful delineation of its component concepts and improved measurement by means of relatively specific indicators. One of the most complete conceptualizations was put forth by the Aston group (Hickson, Pugh and Pheysey, 1969; and Pugh, Hickson, Hinings and Turner, 1969). Hickson, et al. proposed that three major components of technology should be considered in organizational research: materials technology, operations technology and knowledge technology. The distinct advantage of considering these three broad components is that they serve to organize the host of more specfic indicators that have been used by previous (and subsequent) researchers. The Aston group, following Perrow (1967), defined materials technology to include the characteristics of the objects or raw materials used in the workflow. These authors also adapted the concept of knowledge technology from Perrow (1967). This they considered to be the characteristics of knowledge or skills used in the workflow. The concept of operations technology was defined to be the equipping and sequencing of activities in the workflow.

Although they devote only a little space to their discussion of the term workflow, it is obvious from the definitions that they offer for the three components of technology that this concept plays an important role

in their scheme. In their usage, the term workflow refers to what transformations are made in converting raw materials into products, that is, the series of tasks that must be accomplished in order to achieve the desired transformation. Thus, the three components (materials, knowledge and operations) are major aspects of the elaboration of how the sequence of steps in the workflow is accomplished.

Three important characteristics of the Hickson et al. (1969) study have limited the impact of their conceptualization. First their study actually addressed only operations technology. Since they did not attempt to measure either the materials or knowledge components of technology, their work has no overlap with that of Perrow (1967) and those who have adopted his perspective (Lynch, 1974; Van de Ven and Delbecq, 1974). Second, their interest in the impact of organizational technology upon organizational structure dictated the measurement of technology at the organizational level. This distinguishes their work from many of the investigations that have attempted to measure technology at the individual level (e.g., Hage and Aiken, 1969). Moreover, they tacitly assumed that organizations could be characterized by a single organizational workflow. This is perhaps understandable, given that their sample of organizations was dominated by small to medium sized industrial plants, but it nevertheless is a serious limitation.

The notion of a single "organizational" technology has been criticized by a number of recent writers including Jelinek (1977). Briefly stated, the argument is that, although the organization as a whole may perform some specific function (e.g., manufacture automobiles),

not everyone who works in the organization is directly tied to the production of that output. Many, if not most, organizations have employees who perform duties only peripherally related to the primary function of the organization. Among these are staff functions, such as personnel, accounting, and marketing. Since the outputs of these departments are very different from the primary output of the organization, it seems misleading to consider these workers to be working with the same technology as that of the production line workers. The same argument can be applied to departments responsible for different segments of the production line. Shipping/receiving departments, even though they are nominally part of the same workflow, might be considered to have different technologies since the transformation that they make is a locational transformation. This point has been demonstrated empirically by Rousseau (1978) and by Walsh, Taber and Beehr (Note 1). Indeed, this logic can be extended a step further if one seeks to define technology at the level of the individual worker. Accordingly, one might reason that the measurement of "technology" at the individual level is quite closely related to "job analysis." The connection between these two concepts will be treated in more detail in the next section.

Technology and Job Analysis

Although not pursued by the Aston group, the materials and knowledge components of technology have been addressed by others. Lynch (1974) building on Perrow's (1967) work, developed a measurement instrument that attempted to characterize the technology of library units. The most salient items in this questionnaire as well as the instrument used by

Van de Ven and Delbecq (1974) could be conceptualized as measuring a task routineness dimension. To a great extent, these items reject a definition of technology in terms of the content of the tasks that are required to be performed. Instead, technology is defined by the relationship between the materials to be processed and the worker who is to transform them. While a definition in terms of the content of the tasks to be performed might be called a substantive characterization of the technology of a workplace, the latter could be called a formal definition of technology. Formal, in this context, would indicate that abstract qualities, such as the standardization of the input materials, and the variability and predictability of the workload, are of interest.

The substantive characteristics of technology are equivalent to what the job analysis literature refers to as job content or task oriented job analysis (McCormick, 1976). Task-oriented analysis is commonly distinguished from worker-centered analysis which deals with the attributes required of the worker--whether these be job specific knowledge and skills or more general abilities, as proposed by Fleishman (1967). In any event, the components of knowledge/skill or ability utilized in the job analysis literature are considerably more specific and comprehensive than the indicators of knowledge technology found in the organizational literature on technology.

The situation is reversed with respect to the development of indicators of materials and operations technology. Such formal characteristics of materials technology as workload variation and workload predictability do not seem to have been considered in the job

analysis literature. Mead and Christal (Note 2), however, do report an attempt to measure job and task difficulty.

Likewise, aspects of operations technology seem to have been ignored in the job analysis literature. Neither automaticity of tools and equipment (Amber & Amber, 1962), feedback (Taylor, 1971) nor workflow rigidity (Hickson, et al., 1969) are addressed. In short, technology and job analysis—particularly worker-centered job analysis--appear to have overlapping but nonetheless distinct concepts. Though both share the common area of knowledge (or more generally skill or ability) technology, worker centered job analysis, especially as exemplified by the Position Analysis Questionnaire (McCormick, Jeanneret & Mecham, 1969) contains unique aspects whose relationship to materials and operations technology remains to be explored.

II. DATA SOURCES

Navy Occupational Task Analysis Program (NOTAP)
(Secondary Data Source)

Since July of 1973, the Navy has been conducting an extensive series of job analyses. The purpose of the program is to provide Navy managers with information about personnel needs and requirements. This is accomplished through the collection of detailed information about a wide array of possible activities performed by incumbents in most jobs held by enlisted naval personnel. Although the questionnaires used have a heavy emphasis upon the tasks that are performed and the equipment that is used to perform those tasks, there are items that are worker centered in their focus. As will be described later, the worker centered data includes the extent to which tasks require different kinds of physical and mental abilities (e.g., shoulder strength, foot-eye-hand coordination, ability to estimate speed and the like). In addition to the detailed task oriented and worker centered job analysis data, information is also gathered about individual satisfaction with a number of aspects of the work environment.

These data are used by the Navy to provide an empirical basis for making a number of personnel decisions. These decisions include determination of the kinds of training required of people in certain job classes, and whether more of a certain kind of training is needed. Moreover, the job analysis data provide information for such areas as manpower planning, career planning, selection and recruitment, the assessment of personnel utilization and personnel research. A specific

use has been the consolidation of ratings or training programs in which it was found that persons in two different ratings performed very similar kinds of tasks after completion of school. In short, the program (and thus the questionnaire) has been actively used to streamline many of the Navy's personnel functions.

The Task Inventory

The questionnaires used to collect the NOTAP data are generally administered by NOTAP staff. Eligible respondents are enlisted personnel who have held their jobs for at least six months. To assure the external validity of the research, the questionnaires are administered to a stratified random sample of incumbents that includes from 20% to 60% of the persons holding a particular rating depending of the size of the rating being assessed.

The standard questionnaire form used at the time the data for the study were collected included: (1) 26 questions on demographic and background characteristics, (2) 40 questions on general quarters and watch duties, (3) 40 questions on physical and mental job characteristics, (4) 40 questions on job satisfaction, (5) 40 questions on collateral duties, (6) 25 questions on such issues as special knowledge requirements and use of selected reference material, (7) up to 400 questions asking about the use and repair of equipment, and (8) as many as 600 questions relating to various tasks the respondents may perform.

Of these questionnaire sections only the background characteristics, physical and mental job characteristics, job satisfaction and task sections were used for the analytical purposes of the present study.

Background Characteristics. Questions used from the background characteristics section included job title, length of military service, and paygrade. In addition, one question asked the respondent's intention about what he or she will do after the current enlistment period was completed. The response alternatives were: (1) Separate, (2) Uncertain, (3) Reenlist, and (4) Retire.

Physical and Mental Characteristics Required. To arrive at these characteristics of the job, the respondents were given the following instructions:

> The possession of certain unlearned or basic qualities, known as job characteristics, are required to perform certain jobs. This section is used to identify what characteristics are necessry for your present job.
>
> From the list, select all the characteristics that are necessary to perform your present job, and under the corresponding number indicate the amount needed.

The individual items from this section are displayed in Table II-1.

Job Satisfaction. The instructions for the satisfaction questions are:

> The statements which you will read are not intended to invade your privacy as an individual or compromise your position as a member of the U.S. Navy. They are designed to provide you a way of expressing how you feel about your job and the environment in which you work. Your responses provide valuable information to be studied and considered for making future improvements in your rating.
>
> From the list, select all the items that you feel apply to you and your present job, and give an evaluation on how much satisfaction there is now in that specific area.

TABLE II-1

Physical and Mental Characteristics
Used in Meeting Job Requirements

1. Finger, hand, wrist, and forearm strength
2. Upper arm strength
3. Back and shoulder strength
4. Leg, food, and ankle strength
5. Foot-eye-hand coordination
6. Ability to perform rapid work for a series of short periods
7. Ability to perform rapid work for extended periods
8. Ability to perform heavy work for a series of short periods
9. Ability to perform heavy work for extended periods
10. Ability to stand for extended periods
11. Maximum height limitations
12. Minimum height limitations
13. Maximum weight limitations
14. Minimum weight limitations
15. Sharpness of vision
16. Sharpness of hearing
17. Ability to distinguish between different colors and shades (color perception)
18. Ability to estimate size
19. Ability to estimate speed
20. Ability to estimate quality
21. Ability to discriminate by touch ("feel" of objects)
22. Ability to discriminate between odors (sense of smell)
23. Ability to discriminate between salty, sour, sweet (sense of taste)
24. Ability to remember names, places, ideas
25. Ability to remember oral instructions
26. Ability to work with mathematical computations or formulas
27. Ability to plan projects or events
28. Ability to make oral presentations (such as lectures, briefings)
29. Ability to draft or write reports, correspondence
30. Ability to give attention to several items at the same time
31. Ability to concentrate amid distractions
32. Ability to work as a team member
33. Ability to perform detailed work over extended periods of time
34. Ability to work in high places
35. Ability to work in extremely cold temperatures
36. Ability to work in extremely hot temperatures
37. Ability to work under pressure and stress
38. Ability to work in confined areas

The items used in this section of the questionnaire are presented in Table II-2.

Task Statements. Because they vary from rating to rating and because of the extreme length of this section of the questionnaire, all of the individual items in this section will not be presented in this report. The instructions for the section are:

> The following section is a list of task statements that are performed by personnel in your rating. They are used to identify what you do in your present job.
>
> From the list, select all the task statements that apply to you when you perform your present job. Under the corresponding number, evaluate how much time is spent on that task (relative to your other task performed) and in what capacity you perform that task.
>
> Note: If a task statement does not apply to you when you perform your present job, leave the item number blank.

Some sample questions are presented in Table II-3.

Technology Ratings
(Primary Data Source)

In order to develop a set of items to measure technology, recent articles in the organizational literature on technology were reviewed. Primary emphasis was placed on items that measure technology at the individual level. Most items found in the literature addressed the materials and knowledge components of technology. Although few items were found that were explicitly intended to measure the operations component of technology at the individual level, other items suitable

TABLE II-2

Job Satisfaction

Job Satisfaction
- Present duty station
- Overall job
- Overall military career

Job Scope
- Opportunity to do worthwhile work
- Job appeal
- On-the-job training
- Formal school training for the job
- Adequate tools/supplies to do the job
- Recognition for work done
- Freedom to do the entire job
- Freedom from job pressures
- Guidance received to do a job
- Opportunity to do the job for which you are best qualified
- Opportunity to see work results
- Freedom from frequent job changes within the activity
- Job challenge
- Acceptance of your recommendations
- Opportunity to demonstrate your capability
- Opportunity to contribute
- Opportunity for prestige and status within the organization
- Opportunity for helping others
- Opportunity to select location of duty station

Job Context
- Adequacy of work surroundings (such as hazardous conditions)
- Competence of supervisors
- Working relationships with supervisors
- Competence of subordinates
- Working relationships with subordinates
- Proper utilization of money
- Proper utilization of material
- Proper utilization of personnel
- Opportunity for advancement
- Adequacy of pay/allowances
- Adequate BEQ/barracks
- Adequate shipboard living spaces
- Adequate on-base housing
- Adequate off-base housing
- Deployment time away from home port
- Working schedule (tempo of operations)

TABLE II-3

Task Statements

1. Review enlisted performance evaluation (Dept/Div level)
2. Make personnel assignments
3. Assign work priorities
4. Write billet/job descriptions
5. Screen messages, bulletins, correspondence, and other directives for appropriate action
6. Review manpower requirements
7. Coordinate with military activities for required maintenance
8. Initiate action to obtain required personnel for own area of responsiblity
9. Monitor training program
10. Represent command at conferences and meetings
11. Evaluate operational commitments in order to schedule workload
12. Perform as a member of an operational readiness inspection (ORI) team
13. Prepare casualty report (CASREPT)
14. Review/update casualty report (CASREP)
15. Prepare/submit situation report (SITREP)
16. Prepare division/department budget
17. Inspect ships hull while in drydock (such as, shafts, zincs, sea/chest, propellers)
18. Write enlisted performance evaluations on subordinates
19. Make work assignments
20. Prepare watch bills

for this purpose were found in Module 4 of the Michigan Organizational Assessment Package (Note 3).

Measures of materials technology could generally be considered to fall into one of four primary areas: standardization of input materials, complexity of input materials, workload variability and workload predictability. Each area relates to a different aspect of variability or uncertainty about input materials. Specific items included in these areas are displayed in Table II-4, which shows each item.

Measures of the operations component of technology in the areas of automaticity (Amber & Amber, 1962) and feedback (Taylor, 1971) were obviously appropriate for inclusion. In order to address the concept of workflow rigidity, items were adapted or constructed that were designed to measure interdependence, worker mobility and pace control. Items for the operations technology scale are found in Table II-5.

Four of the measures of knowledge technology dealt with the information available to the worker to complete his tasks. These are presented in Table II-6. However, one could argue that this component of technology should also include skills or abilities rather than knowledge alone since many jobs in industrial settings have significant noncognitive requirements. For example, perceptual acuity--the ability to discriminate differences among inputs--is frequently every bit as important as the cognitive ability (i.e., knowledge) to respond appropriately to those differences. Physical skills, including strength, dexterity and perceptual acuity; cognitive abilities such as memory and abstract reasoning; and environmental tolerance are all areas that are

TABLE II-4

Materials

Think of all the kinds of events that cause work on this job. How often would you say the typical man is able to anticipate and predict the nature of these events?

(1)	(2)	(3)	(4)
Never	Rarely	Sometimes	Often

If you wrote a list of the exact activities the typical person would be confronted by on an average work day, what proportion of these activities do you think would be interrupted by unexpected events?

_____% (percent)

On some jobs the work that is to be performed comes in at a steady pace. On others the workload may be greater during certain hours of the day, on certain days of the week, or after the occurence of certain events. How would you characterize the typical workload variation on this job?

(1)	(2)	(3)	(4)
There are major variations in the workload	There are significant variations in the workload	There are small variations in the workload	The workload is very steady (no significant variations)

How predictable are the variations in the typical workload in this job?

(1)	(2)	(3)	(4)	(5)
No significant workload variations	Workload variations are highly predictable	Workload variations are moderately predictable	Workload variations are minimally predictable	Workload variations are unpredictable

During the course of this kind of work, who often does the typical man come across specific difficult problems that he doesn't immediately know how to solve?

(1)	(2)	(3)	(4)
Never	Rarely	Sometimes	Often

TABLE II-4 (continued)

There are hardly any exceptional cases in the things the typical man in this job has to work on; almost nothing is unusual.

(1)	(2)	(3)	(4)	(5)
Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

In some jobs things are fairly predictable. In others, you are often not sure what the outcome will be. What percentage of the time is the typical person generally sure what the results of his efforts will be?

_____% (percent)

TABLE II-5

Operations

AUTOMATICITY

Of the following types of machinery, which type is most commonly used by the typical man on this job? (check only one)

1 Hand tools and manually operated machines

2 Powered tools and machines

3 Single-cycle automatic and self-feeding machines

4 Automatic; repeats cycle

5 Self-measuring and adjusting machines; the machine guides and adjusts itself while operating

Of the following types of machinery, which type is the most sophisticated type of machinery used by a typical man on this job? (check only one)

1 Hand tools and manually operated machines

2 Powered tools and machines

3 Single-cycle automatic and self-feeding machines

4 Automatic; repeats cycle

5 Self-measuring and adjusting machines; the machine guides and adjusts itself while operating

FEEDBACK

On the average, how long is it before the typical man knows whether his work effort is successful? Is it a matter of:

(1)	(2)	(3)	(4)	(5)	(6)
Seconds	Minutes	Hours	Days	Weeks	Months

TABLE II-5 (continued)

In some jobs, workers get feedback just from doing the job (without anyone telling them). To what extent can the typical man in this job get such feedback just from doing the work?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

Of the following alternatives, which one best describes the way in which the typical man's work is evaluated for quality?

1 Personal evaluation by a superior

2 Partial measurement of some aspects of the work

3 Measurements of virtually the entire piece of work compared to precise specifications (blueprint or equivalent)

WORKFLOW RIGIDITY

On some jobs, work originates from many sources. These sources may be other units, other sections, other workers, or machines. On other jobs, work comes from only a single source. How many sources of work are there for this job?

_____ (number of scurces)

On some jobs, workers send their completed work to one of a number of destinations. These destinations may be other units, other sections, other workers or machines. On other jobs work goes only to a single destination. How many destinations are there for the work that is done by the typical man in this job?

_____ (number of destinations)

On some jobs, one set of workers cannot begin their tasks until another set have completed theirs. On other jobs, workers can perform their tasks independently of one another. To what extent does he typically depend upon others to complete tasks before he can begin his own work?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

TABLE II-5 (continued)

To what extent is he required to complete his tasks before others can begin their work?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

How much does the typical man have to cooperate directly with other people in order to do his job?

(1)	(2)	(3)	(4)	(5)
Very little, he can do almost all his work by himself	Somewhat	A moderate amount; some of his work requires co-operating with others	Much	Very much, all his work requires cooperating with others

How often does his job require that this typical man meet or check with other people?

(1)	(2)	(3)	(4)	(5)
Not at all; he never has to meet or check with others	Occasion-ally	He sometimes needs to meet or check with others	Often	Very much; he must constantly meet or check with others

On some jobs, the worker is a part of an overall coordinated sequence of operations. On other jobs, the worker produces an entire product or service by himself. To what extent is the typical man's job a part of an overall sequence?

(1)	(2)	(3)
His job involves only a small part of the sequence of operations	His job involves doing a moderate sized "chunk" of the work; others may be involved, but his job constitutes a major portion of what needs to be done	His job involves producing an entire product from start to finish

TABLE II-5 (continued)

On some jobs, the worker must remain at a particular work station in order to perform his tasks. On other jobs workers can move freely. How important is it for him to remain at a fixed work station (or desk) in order to properly perform his work?

(1)	(2)	(3)	(4)	(5)
There is no work station	Unimportant	Somewhat important: some tasks must be performed at the work station, but others need not	Very important	Extremely important: it is impossible to do any work away from the work station

To what extent does the typical man in this job have control over the rate at which work comes to him?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

To what extent does he have control over the rate at which is work has to be completed?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

ROUTINIZATION OF OPERATIONS

Every job has certain routine and repetitive activities. What proportion of the activities or demands connected with this job would you consider to be routine or repetitive?

_____% (percent)

TABLE II-5 (continued)

How much variety in actual work tasks does the typical man generally encounter in his working day?

(1)	(2)	(3)	(4)	(5)
Very little, he does the same things over and over, using the same equipment and procedures almost all the time	Some variety	A moderate amount	Much variety	Very much, he does many things using a variety of equipment and procedures

Regardless of the variety of different work tasks, to what extent are the same methods used for handling them?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

In doing their jobs from day to day, men in this job generally have to adopt different methods or procedures to do their work.

(1)	(2)	(3)	(4)	(5)
Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

TABLE II-6

Knowledge

To what extent is there a clearly defined body of knowledge or subject matter which can guide the typical person in doing this job?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

To what extent is there an understandable sequence of steps to be followed in accomplishing this work?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

In general, how much actual thinking time does the typical person usually spend trying to solve such specific problems? Is it a matter of:

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Seconds	Minutes	Hours	Days	Weeks	Months	No such problems encountered

If there is something that a typical person doesn't know how to handle on this job, to what extent can he go to someone else for an answer to the problem?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

addressed in the section of the NOTAP questionnaire on physical and mental requirements. Four additional measures adapted from the worker function hierarchy in the Handbook for Analyzing Jobs (U.S. Department of Labor, 1972) were included in the technology questionnaire (see Table II-7). These four items addressed the extent to which the job incumbent was involved in setting up or operating precision equipment (a high level relationship to things), manual labor such as loading or offloading (a low level relationship to things), analyzing or drawing conclusions from data (a high level relationship to data), and clerical duties such as copying or comparing data (a low level relationship to data).

Instrument Administration. Following selection of the set of candidate measures, items were pretested to assess the clarity of the wording of items and the coherence of the items as a group. The pretest, administered to a set of clerical workers, revealed some problems in applicability to clerical jobs of items concerning workflow characteristics. Following reworking of some items, the technology questionnaire was administered to 54 noncommissioned officers E-5 through E-7 at the Great Lakes Naval Training Center. Each respondent selected two job titles from his own rating that were represented in the NOTAP data files. Respondents were asked to rate the "typical" incumbent of a given tob title. Although it would have been desirable to have ratings of incumbents whose job settings were more specifically described--particularly with respect to type of ship, constraints on data collection precluded this approach Thus, we ended up gathering rather

TABLE II-7

Skill

To what extent is he involved in highly skilled activities such as setting up or operation of precision tools or equipment?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

To what extent is he involved in manual labor such as handling materials or feeding and removing materials from machinery?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

To what extent is the typical man in this job involved in information processing activities such as analyzing or drwing conclusions from data other than written materials?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

To what extent is he involved in clerical duties such as copying, comparing or compiling data?

(1)	(2)	(3)	(4)
Not at all	To some extent	To a large extent	To a very great extent

general descriptions of jobs. This to some extent limits the degree of convergence between these ratings and the way a job would be described by a particular job incumbent.

III. SCALE ANALYSES

This section describes the procedures used to select ratings and, subsequently, specific job titles within those ratings. Results of interrater analyses for the technology measures and item analyses for the Technology questionnaire, the Required Physical and Mental Characteristics section from the NOTAP data set and the Job Satisfaction measures (also from NOTAP) are presented.

Selection of Ratings and Job Titles

The ratings selected for analyses were the Electrician's Mate (EM), Engineman (EN), and Gunner's Mate (GM) ratings. Several criteria were used to make this selection. The first was that the NOTAP questionnaire administration was to have occurred at roughly the same point in time. This was to insure that differences in job title were not confounded with differences in external conditions such as military pay levels, national economic conditions or the like. The second was that there should be some variance among ratings in the types of jobs that were performed. Further, there should be some variance in job content within each of the ratings.

A rough screening of the ratings was made on the basis of descriptions contained in recruiting films and in the Navy Career Guide 1977-78. The determination of the number of respondents in each rating and Naval Enlisted Classification was provided by the Navy Occupational Development and Analysis Center, which conducts the operations of NOTAP.

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Following acquisition of data tapes for the three ratings which were chosen, analyses were conducted to determine the most appropriate job titles for further study. As a first step, any job title with a sample size less than 10 was dropped from further consideration. Next, the remaining job titles were profiled on the task inventory items to determine patterns of similarity and dissimilarity. In this step of the analysis, individual items were aggregated into "scale scores" where the scales were composed of task statements with similar content. These scales included Administrative tasks, Management tasks, Supervisory tasks, Training tasks, and Supply tasks as well as a large number of technical task areas which differed with rating (see Table III-1). The mean scale score for all respondents within a job title was recorded for each of the task areas. Profiles for all job titles within each rating were compared to eliminate job titles with similar content. The remaining job titles constituted the sample of jobs for the present study. They were recorded on the technology questionnaire. Instructions called for the technology raters to select the two job titles with which they were most familiar.

Interrater Analysis of Technology Items

Table III-2 shows the job titles that were selected within each of the ratings, the number of non-commissioned officers who rated that job title, the interrater reliabilities of those raters, and the number of job incumbents from the NOTAP data set that were in that job title. In general, these reliabilities were satisfactory, although not as high as is desired. Given the circumstances in which the data were collected,

TABLE III-1

Task Areas for Ratings

Electrician's Mate Rating

A	Management
B	Supervision
C	Administration
D	Training
E	Supply/Fiscal
F	Planned Maintenance System
G	Power Generation (General)
H	Power Generation (Specific)
I	General Electrical Maintenance
J	Power Distribution
K	Electronic Controlled Equipment
L	Audio Visual Equipment
M	Heavy Power Equipment
N	Light Power Equipment
O	Gas Turbine Propulsion
P	Aviation Systems Equipment
Q	Minesweeping
R	Shop Repair Operations
S	Controllers and Motors
T	Special Systems
U	Automated Propulsion System
V	Alarms
W	Lighting
X	Electically Driven Vehicles
Y	Hotel Services Equipment
Z	General Military Duties

TABLE III-1 (continued)

Engineman Rating

A	Management
B	Supervision
C	Administration
D	Training
E	Supply
F	Technical Administration
G	PMS
H	Main Propulsion
J	Auxiliary Systems
K	Air Cond. & Refrig.
L	Pumps/Piping/Fuels/Tankage
M	Handling Equipment
N	Controls and Indicators
P	Personnel Services Equip.
Q	Small Craft Maintenance
R	Internal Combustion Engine
S	Fuel injectin & Ignition
T	Engine Air Intake and Exhaust
U	Miscellaneous
Z	General Military

Gunner's Mate Rating

A	Management
B	Supervision
C	Administration
D	Training
E	Supply
F	Gun Systems
G	Missile Systems
H	Small Arms
L	Shipboard Loading/Transportation Systems
M	Magazine/Handling/Storage
N	Bombs/Warheads/Warhead Sections
P	General Maintenance
Z	General Military Duties

TABLE III-2

Number of Raters, Interrater Reliabilities (α) and Number of Job Incumbents for Each Job Title

Rating	Job Title	Raters	α	Job Incumbents
EM	Supply Petty Officer	8	.823	98
EM	Battery Locker Electrician	2	.500	92
EM	Electrical Motor Rewinder	5	.773	124
EM	Safety Shop Electrician	5	.688	68
EM	Power Shop Electrician	2	.615	143
EM	Lighting Shop Electrician	3	.672	135
EM	Distribution Shop Electrician	4	.541	122
EM	Electrical Propulation Shop Electrician	2	.652	50
EM	Electric Shop Electrician	4	.634	883
EN	Engine Room Suppervisor	5	.705	102
EN	Throttleman	2	.533	38
EN	Leading Petty Officer	2	.565	119
EN	Oil King	3	.848	69
EN	Boat Shop Supervisor	2	.587	51
GM	Launcher System Maintenance Man	6	.855	67
GM	Leading GM/PO	3	.784	106
GM	Armory PO	4	.723	43
GM	Launcher Supervisor	4	.723	24
GM	5"/54 Maintenance Man/Technician	3	.567	90
GM	Supply PO	5	.793	25
GM	3"/50 Maintenance Man	2	.689	92
GM	Gunner's Mate	2	.668	120
GM	Work Center Supervisor	2	.603	79
		80		2740

this is to be expected. As the respondents to the technology questionnaire indicated, the answers to some questions depend upon the duty station. Especially for those job titles with a heavy involvement in corrective maintenance, significant differences in the measures could occur depending upon the size of the ship and the ability of the job incumbent. Interrater reliabilities would be depressed in such a case because different raters were, in effect, rating somewhat different jobs. It should also be noted that these reliabilities are based upon the use of all of the technology items and could possibly be depressed by the inclusion of unreliable items.

The organization of the technology items presented in Tables II-5, II-6, and II-7 is based upon a priori conceptual considerations. It is also important to examine the empirical correlations among the variables as well. Items that are conceptually related may have low or zero empirical correlations. Two items that are both measures of knowledge technology (i.e., are conceptually correlated) may load on different factors in a factor analysis (be empirically uncorrelated) because there is no systematic behavioral relationship between them. For example, involvement in "setting up precision equipment" and "loading/offloading materials" are conceptually similar because both are measures of involvement with things, rather than with data or people. Whether or not responses to these items are empirically related is an open question. Characterizing these items as points on a scale of skill level--as they are typically conceived (see, for example, McCormick, 1976)--implies that they are negatively correlated. Jobs that are high on "setting up" would

be low on "handling" and vice-versa. These items may or may not form this type of (Thurstone) scale. They may form a Guttman scale--incumbents who engage in "setting up" also do "handling," but those who do "handling" do not perform "setting up." Or the items may form a summative scale in which jobs vary independently in the amount of "setting up" and "handling" that are required.

Whichever model holds, it is important to realize that the factor analyses that will be reported below need to be interpreted with some caution. Failure of the factor analysis to confirm the *a priori* conceptual relationships may be due to discrepant scale types or to any of the explanations given in the previous section for the imperfect interrater reliabilities.

Item Analysis of Technology Measures

Initially, the technology items were analyzed as a single pool. However, the resulting factor analysis was unsatisfactory in a number of respects. First, the number of factors indicated by the scree test (Cattell, 1966) was inconclusive. Second, there was an excessive number of items designed to tap one component of technology (e.g., knowledge of materials) that loaded with items tapping another aspect (e.g., operations). In order to deal with these problems, a "jackknifed" factor analysis was attempted. This procedure, accomplished by means of the computer program TUKKNIFE (see Appendix A) was used to compute empirical estimates of the standard errors of the factor loadings of the technology items. The results of the jackknife analysis indicated that the standard errors of the factor loadings were relatively large and, consequently,

the problem of cross-loadings of items from one component of technology on another was not resolved.

The items were then divided into three groups. The first group consisted of the four items dealing with the level of involvement in skilled and unskilled physical and mental activities. As indicated previously, these items are of distinctly different origin from the others. That, together with the unresolved issue of their scalability was judged to be sufficient grounds for a separate analysis.

The second group of items consisted of those items that could be unambiguously assigned to the operations component of technology. They were separated from the remainder of the items to avoid the possible confounding of different levels of analysis. Such a confounding could occur if an indicator of an operational consequence were more highly correlated with a corresponding indicator of materials or knowledge than with other aspects of operations. Such a result could occur if, for example, an item dealing with input standardization were highly correlated with an item on routinization of work methods because of similar wording or a common referent.

The items dealing with knowledge and materials technology were analyzed together because the knowledge items were relatively few in number and because many of the items tapped aspects of both concepts. This is a particularly difficult problem in assessing the technology of jobs outside the manufacturing industry since many of the items addressing input standardization assume a particular level of knowledge on the part of the incumbent. Specifically, an item on the "frequency

with which a job incumbent comes across specific difficult problems that he doesn't immediately know how to solve" could be responded to as a materials (input standardization) item or as a knowledge item.

In the analysis of the activities items, the number of factors was specified to be two. It was anticipated that the first factor would separate the cognitive activities from the physical activities and that the second factor would separate the skilled from the unskilled. The obtained pattern was, however, just the reverse: the skill level factor (TECH11, Table III-3) emerged first. Moreover, on the second factor (TECH12) the magnitudes of the loadings for the items were in the order unskilled physical, skilled physical, skilled mental and unskilled mental. Differences in the magnitude of the loadings on the second factor were all approximately equal. This suggests that for these jobs, skill level is a more important differentiating construct than is skill content.

A scree test analysis of the eigenvalues of the matrix of correlations of the operations technology items showed large breaks at ten, eight and six factors. The six factor solution provided a clearly interpretable structure although one factor had poor reliability. Each of the remaining five factors consisted of a pair of items dealing with automaticity (TECH7), pace control (TECH10) and the three subscales of workflow rigidity (TECH4, TECH5 and TECH6).

Analysis of the items related to the knowledge and materials components was similar to the analysis of the operation items. The roots of the correlation matrix were plotted and inspected for breaks.

TABLE III-3

Reliability and Item Content of Technology Scales

SCALE	RELIABILITY	ITEM CONTENT
TECH1 Task difficulty/ predictability	.638	Predictability of variations in workload (m) Frequency of difficult problems (m) Percent of time worker is sure of results of efforts (m)
TECH2 Problem ambiguity	.646	Proportion of activities interrupted (m) Amount of thinking time spend trying to solve problems (k) Length of time to determine if work effort is successful (o)
TECH3 Availability of feedback	.550	Can go to someone else for an answer to problems (k) Feedback from work itself (o)
TECH4 Input/output paths	.697	Number of sources of work (o) Number of destinations for work (o)
TECH5 Horizontal interdependence	.660	Depends upon others to complete tasks before he can begin (o) Required to complete tasks before others can begin (o)
TECH6 Interdependence	.700	Must cooperate directly with others (o) Must meet or check with others (o)
TECH7 Automaticity	.803	Most commonly used machinery (o) Most sophisticated machinery used (o)
TECH8 Task definition (Knowledge)	.577	Clearly defined subject matter to guide worker (o) Understandable sequence of steps to be followed (o)
TECH9 Task routineness	.578	Variety in work tasks (o) Variety of work methods (o) Few exceptional cases (m) Methods and procedures differ from day to day (o)

TABLE III-3 (continued)

SCALE	RELIABILITY	ITEM CONTENT
TECH10 Workpace control	.630	Ability to predict events that cause work (m) Workload variation (m) Control over rate of input (o) Control over rate of output (o) Proportion of routine activities (o)
TECH11 Skilled activities	.605	Skilled physical activities (s) Information processing activities (s)
TECH12 Unskilled activities	.453	Manual labor (s) Clerical duties (s)
TECH13 Mobility	***	Importance of fixed work station (o)
TECH14 Identity	***	Part of a coordinated sequence of operations (o)
TECH15 Feedback precision	***	Standard of quality evaluation (o)

Note: *a priori* assignment denoted by materials (m), knowledge (k), operations (o) or skill (s).

Although four factors were indicated, one factor contained an excessive number of cross-loaded variables and was dropped from further analysis. Items were assigned to the scales corresponding to the factor on which they loaded highest and the reliabilities of the scales estimated by coefficient alpha. Some items were deleted if so doing would raise the reliability of the scale.

Following these three factor analyses, items that did not load on scales within their component of technology were examined to determine whether they were misplaced. Thus, isolated items from the operations section were correlated with items in scales from the knowledge and materials components and vice-versa.

Item Analysis of Required Physical and Mental Characteristics

The items included in this section of the NOTAP data set were factor analyzed using a principal factor model with iterated communality estimates. A seven factor solution was selected on the basis of a scree test, which showed a noticeable break in the plot of the eigenvalues between the seventh and the eighth roots. This solution was rotated by the varimax criterion to a readily interpretable structure. Items with loadings greater than .40 were assigned to scales formed from the common factors. Reliabilities for all of the scales (measured by coefficient alpha) were in the range from .621 to .855. Two items did not load on any of the common factors. One of these addressed the job incumbent's perception of the need for foot-hand-eye coordination in his work; the other dealt with the perceived need to be able to stand for extended

periods of time. Table III-4 shows the results of the scale analyses. The estimated reliability and item content for each of the scales are listed.

Item Analysis of the Job Satisfaction Measures

Because of their significance as global indicators, the measures of overall job satisfaction and overall military career satisfaction were analyzed separately from the rest of the items in the job satisfaction section of the NOTAP data set. The remainder of the items were factor analyzed using the same procedure that was used for the data on required physical and mental characteristics. A plot of the roots of the correlation matrix indicated that there was a relatively larger difference between the magnitudes of the seventh (1.10) and eighth (.940) eigenvalues than between the eighth and the ninth (.883). However, the eight factor solution was chosen rather than the seven factor solution because it produced no difference in the loadings on the first six factors and produced a more readily interpreted seventh (and eighth) factor. As with the data from the required physical and mental characteristics, items with loadings greater than .40 were assigned to scales corresponding to the common factor on which they had their maximum loading. This section of the NOTAP data set contained five items that did not load significantly on any of the common factors. These were retained in subsequent data analyses as "single item scales." Reliabilities of the multi-item scales were estimated by coefficient alpha. The results of these analyses are displayed in Table III-5, which shows the name, estimated reliability and item content of each of the scales based upon the common factors.

TABLE III-4

Reliability and Item Content of Required Physical and Mental Characteristics Scales

SCALE	RELIABILITY	ITEM CONTENT
Strength	.826	Hand strength, upper arm strength, back and shoulder strength, leg and foot strength
Endurance	.768	Ability to perform rapid work for short periods. Ability to perform rapid work or extended periods. Ability to perform heavy work for short periods. Ability to perform heavy work for extended periods.
Anthropometric Constraints	.855	Maximum height limits. Minimum height limits. Maximum weight limits. Minimum weight limits.
Perceptual	.811	Vision, hearing, color perception Ability to estimate size Ability to estimate speed Ability to estimate quality Sense of touch Sense of smell Sense of taste
Cognitive	.833	Ability to remember names Ability to remember oral instructions Mathematical ability Ability to plan projects or events Ability to make oral presentations Ability to draft reports Ability to give attention to several items at the same time Ability to concentrate Ability to work as a team member Ability to perform detailed work
Outdoor Tolerance	.621	Ability to work in high places Ability to work in cold temperatures
Indoor Tolerance	.791	Ability to work in hot temperatures Ability to work under pressure Ability to work in confined area.

TABLE III-5

Reliability and Item Content of
Job Satisfaction Scales

SCALE	RELIABILITY	ITEM CONTENT
Satis 1 Meaningfulness	.837	Opportunity to do worthwhile work Job appeal On-the-job training Opportunity to do job for which you are best qualified Opportunity to see work results Job challenge
Satis 2 Responsibility	.771	Adequate tools and supplies Recognition for work done Freedom to do entire job Freedom from pressures
Satis 3 Supervisors	.795	Competence of supervisors Working relationships with supervisors
Satis 4 Subordinates	.785	Competence of subordinates Working relationships with subordinates
Satis 5 Growth needs	.852	Acceptance of your recommendations Opportunity to demonstrate your capability Opportunity to contribute Opportunity for prestige Opportunity for helping others
Satis 6 Resource Utilization	.834	Proper utilization of money Proper utilization of material Proper utilization of personnel
Satis 7 Existence needs	.785	Pay and allowances Adequate barracks Adequate ship-board living space Adequate on-base housing Adequate off-base housing

TABLE III-5 (continued)

SCALE	RELIABILITY	ITEM CONTENT
Satis 8	.531	Deployment time away from homeport
Obtrusiveness		Working schedule
Satis 9	***	Opportunity to select duty station
Satis 10	***	Satisfaction with present duty station
Satis 11	***	Overall job
Satis 12	***	Overall career
Reenlist	***	Reenlistment intention

IV. PATH ANALYSIS OF REENLISTMENT INTENTIONS

The literature reviewed in Section I suggests that a specific causal ordering should be found in the data described here. Characteristics of the technologies that the job incumbents work with should affect the physical and mental characteristics that are required of them. Required physical and mental characteristics in turn should have an effect upon perceived characteristics of the job, which together with job context variables should determine overall job satisfaction. Finally, overall job satisfaction should affect reenlistment intentions. This system of propositions can be represented as a path model, such as that diagrammed in Figure IV-1. It is important to note that the path diagram represents only those systematic influences that are related to the variables within the model. Two important sources of variance are not explicitly considered: unreliability in the measures and omitted variables. The role of unreliability as a disturbing influence has been addressed in the previous section. The effects of omitted variables are also important to consider because some low correlations (or low multiple correlations) are undoubtedly due to such an effect. Comparison of the model presented in Figure IV-1 with the model presented by Mobley, Griffeth, Hand and Meglino (1979, Figure 1) clearly indicates that much of the model that we are testing is a subset of theirs. Specifically, we are focusing upon linkages among organizational characteristics, job related perceptions, satisfaction and intentions to quit. We are not addressing one potentially important determinant of reenlistment intention:

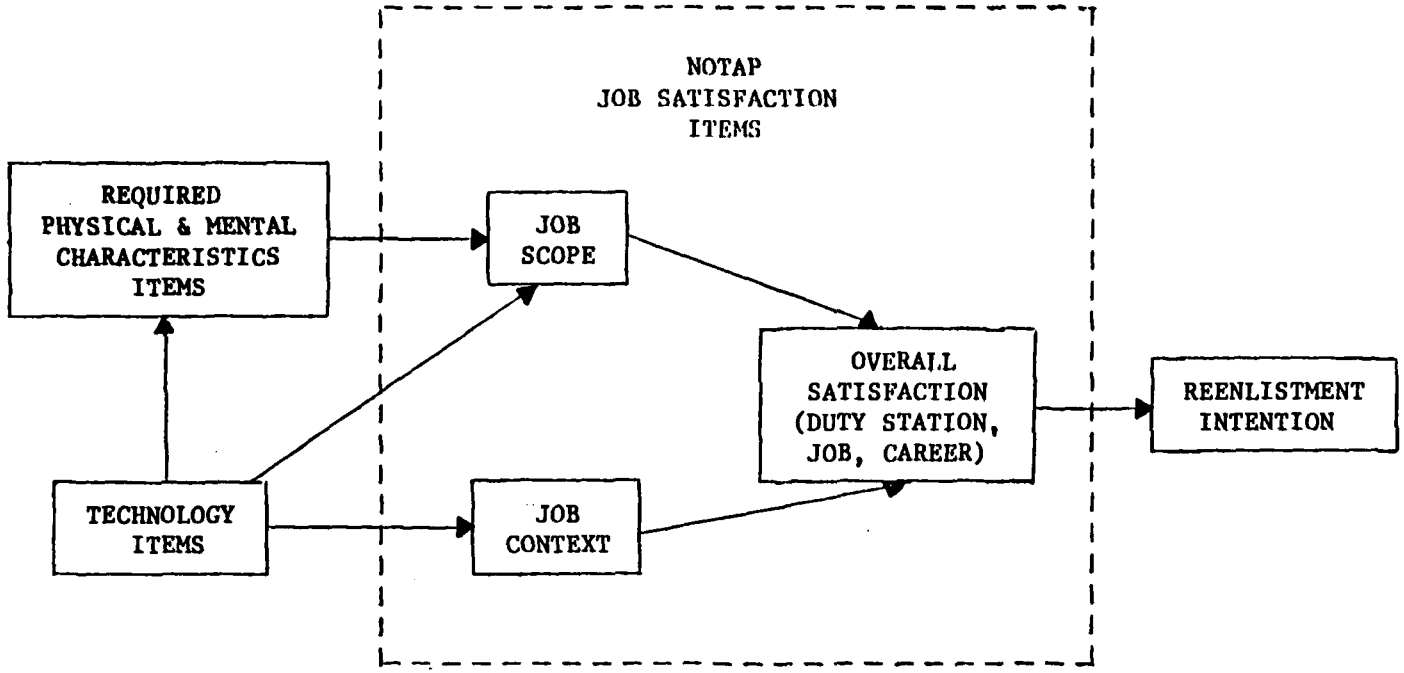

FIGURE IV-1

PATH MODEL OF REENLISTMENT INTENTIONS

expectations of getting a better job in civilian life. Other omitted variables can be expected to have the effect of reducing prediction at different stages of the path model.

This path diagram can be represented algebraically as a recursive system of simultaneous equations (Blalock, 1964). Each of the equations describes the relationship between variables in two or more boxes in Figure IV-1. Equation 1 would describe the model that relates reenlistment intention to overall measures of satisfaction with duty station, job or career. Subsequent equations would describe the models that relate these variables to their presumed antecedents.

In estimating the coefficients associated with this path model, the individual equations will be estimated in "reverse" order, starting with the regression of reenlistment intentions on overall satisfaction, and so on back to the regression of indicators of experienced job characteristics on required physical and mental characteristics and on technological characteristics. For equations with only one explanatory variable, the standardized regression coefficient is also an index of the ability of that variable to account for variation in the dependent variable. For equations with more than one explanatory variable, an index of the predictive power of the variables as a group will be provided. This index, $\hat{R}$, is the multiple correlation coefficient adjusted for shrinkage (Wherry, 1931).

Stage One--Reenlistment Intentions

Of all of the variables in the model, the three that could be most plausibly considered to exert a direct effect on reenlistment intentions

are Satisfaction with present duty station (Satis 10), Overall job satisfaction (Satis 11), and Overall satisfaction with military career (Satis 12). One way of assessing the relative contribution of these three variables is to create an equal weighted composite. The variance accounted for by equal weights can then be compared to the variance in Reenlistment intention accounted for by differential weights. Thus, the three variables were standardized, added together, and the sum correlated with Reenlistment intention. The obtained correlation was .175.

When these variables were used in a stepwise regression to predict Reenlistment intention, Overall satisfaction with career (Satis 12) entered first. At the second step this variable received a much larger weight (β_{12} = .589) than did Overall satisfaction with job (β_{11} = -.081). It is noteworthy that the weight for Overall job satisfaction was of the "wrong sign." That is, the obtained weight was negative even though theoretical reasons clearly indicate that a positive--or at least zero--weight should be found. Moreover, the sign of the regression weight for Overall job satisfaction was opposite the sign of its (zero-order correlation) coefficient. Both of these factors suggest that this equation should be respecified. Deleting Overall job satisfaction (i.e., setting β_{11} = 0) is plausible since adding this variable only raised $\hat{R}$ from .570 to .575. This was not the case when the order of entry was reversed; adding Satis 12 to Satis 11 $\hat{R}$ from .204 to .575. Thus, one can conclude that Overall satisfaction with career and not Overall job satisfaction has a direct effect upon reenlistment intentions. Since Satisfaction with present duty station (Satis 10)

contributed an even smaller increment to $\hat{R}$ than did Overall job satisfaction (from $\hat{R}$ = .570 to $\hat{R}$ = .572), the same argument would apply to this variable as well. In both cases the differentially weighted variables predicted far better than did the equal weighted predictors. In summary, the zero-order correlations between Reenlistment intention and both Overall job satisfaction and Satisfaction with present duty station should be considered "spurious" and due only to their indirect effects on Reenlistment intention *via* Overall career satisfaction. *Only career satisfaction has a direct effect upon reenlistment intention*.

Stage Two—Career Satisfaction

Overall career satisfaction (Satis 12) was then used as the dependent variable in a stepwise regression analysis in which all of the other variables (Satis 1 through Satis 11) from the NOTAP *Job Satisfaction* section were included as potential predictors. Four variables entered the equation: Overall job satisfaction (Satis 11), Satisfaction with duty station (Satis 10, Existence needs (Satis 7) and Resource utilization (Satis 6). The adjusted multiple correlation, $\hat{R}$, for all four predictors was .575. The weights of the four variables (and the $\hat{R}$ for the step at which they centered) were β_{11} = .307 (R = .483), β_{10} = .194 (R = .544), β_7 = .137 (R = .565 and β_6 = .128 (R = .575), respectively. Because of the similarity in the magnitudes of the regression weights of the predictors, an equal weighted composite was formed and correlated with overall career satisfaction. The multiple correlation between the composite and the dependent variable was .564. These results suggest that none of the zero-order correlations obtained

at this level are spurious. Although it is not possible to rule out the hypothesis of equal weights for these four variables as a set, a differential weights model does provide a slightly better fit. Specifying a restricted regression model in which job satisfaction is twice as important as any of the remaining three variables (which are constrained to be equal in importance) produces an $\hat{R}$ of .574.

Stage Three--Overall Job Satisfaction

The set of predictors most appropriate for predicting Overall job satisfaction (Satis 11) was initially selected by means of stepwise regression analysis. The order of entry of the first three variables was Meaningfulness (Satis 1), Obtrusiveness (Satis 8), and Growth needs (Satis 5). The weights that each of the variables received in the final equation, (as well as the $\hat{R}$ for the step at which they entered) were .468 (.632), .229 (.675) and .153 (.683). Because of the high intercorrelation between Meaningfulness and Growth, and the similarity of their zero-order correlations with the dependent variable, the fit of an equal weighted composite of these two variables was tested. At step 1, the composite variable had a higher correlation (.635) than Meaningfulness alone (.632). Since adding Obtrusiveness only raises $\hat{R}$ to .672, the full differential weighted model, (β_1 = .468, β_8 = .229, β_5 = .153) appears to be the most appropriate.

Stage Four--Satisfaction with Present Duty Station

A fourth set of analyses was performed to determine the most efficient set of explanatory variables for satisfaction with Present duty

station. The three variables that entered the regression equation were, in order, Resource utilization (Satis 6), Opportunity to select location of duty station (Satis 9) and Overall job satisfaction (Satis 11). The regression weights from the final equation (and the levels of $\hat{R}$ at each step) were .264 (.465), .282 (.549) and .240 (.590), respectively. That is, Resource utilization, Opportunity to select duty station and Overall job satisfaction were all about equally important. This analysis leads to two interesting results. First, Overall job satisfaction has an indirect effect on Career satisfaction via Satisfaction with present duty station in addition to the direct effect noted earlier. Second, Resource utilization was also shown to have an indirect, as well as a direct, effect on Career satisfaction.

The results of these analyses are diagrammed in Figure IV-2. This figure summarizes all of the direct effects found in the previous sections.

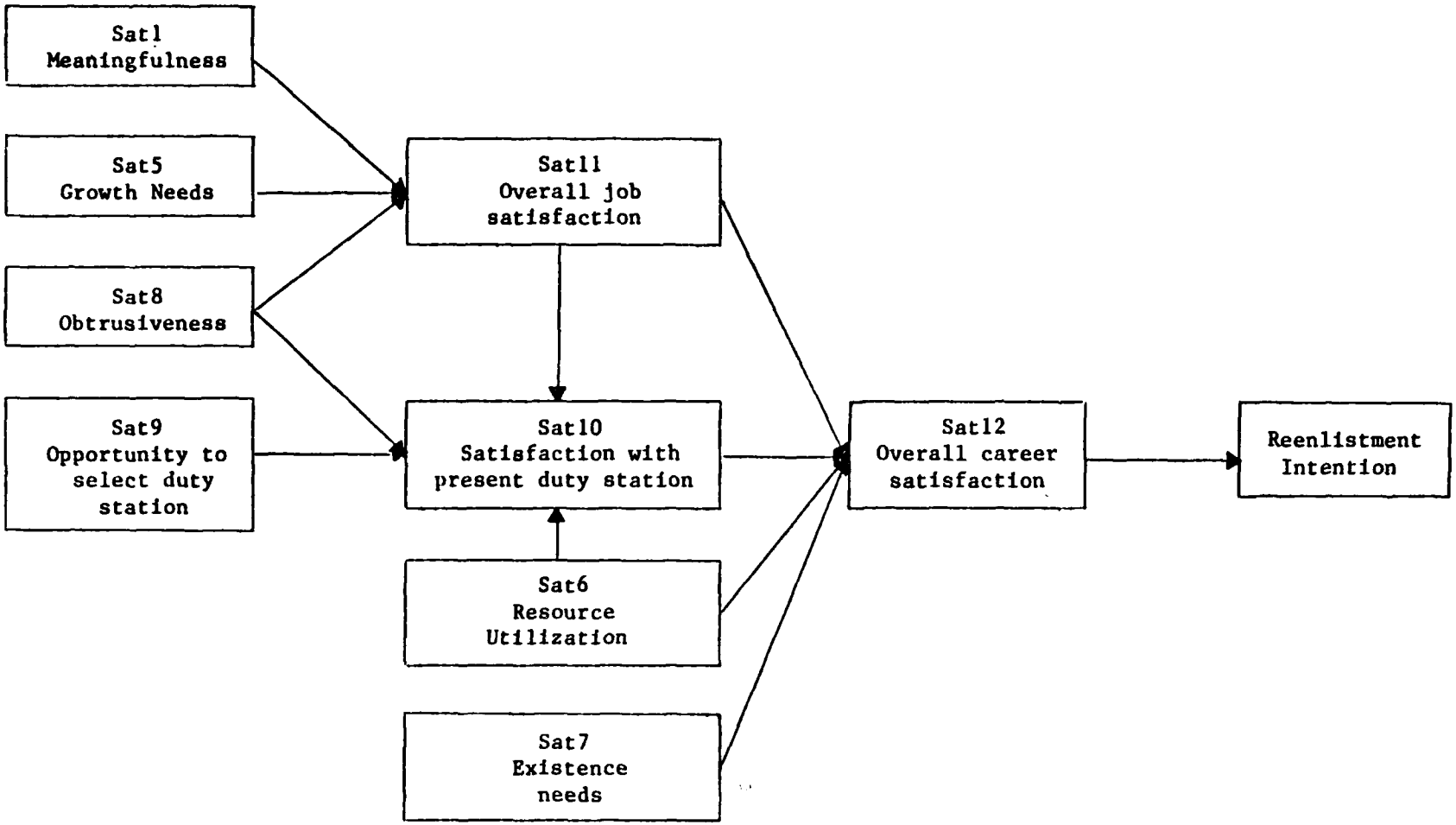

FIGURE IV-2

REVISED PATH MODEL OF REENLISTMENT INTENTIONS

V. JOB ANALYSIS AND TECHNOLOGY ANTECEDENTS OF JOB SATISFACTION MEASURES

Relationships between Job Satisfaction and Job Analysis Measures

Each of the scales formed from variables in the section of the NOTAP questionnaire on Job Satisfaction was used as a dependent variable to be explained by the job analysis variables from the NOTAP section on Required Physical and Mental Characteristics (see items in Table III-4). The results of stepwide regression analysis of the first six scales are shown in Table V-1. Results for the prediction of Existence needs (Satis 7) and Obtrusiveness (Satis 8) are not presented since, in both cases, the adjusted multiple correlations for the first two predictors were less than .05.

Three features of the data displayed in the table are worthy of mention. The first, quite obviously, is the very low level of predictability of the job satisfaction measures from the job analysis measures. Second, those scales that are most closely related to the concept of job scope (Meaningfulness, Responsibility and Growth) do have the highest multiple correlations. Finally scales most appropriately considered to be measures of job context have lower multiple correlations. Moreover, there is a consistent pattern of predictor variables that emerges. The Cognitive requirements scale was selected as a predictor in each equation. Indoor physical environment consistently received a negative weight and generally related only to the job scope variables.

TABLE V-1

Standardized Regression Weights and Adjusted Multiple Correlations for Predicting JOB SATISFACTION Related Scales from JOB ANALYSIS Related Scales

Satisfaction Scale	Regression Weights		
	Cognitive	Indoor	R
Satis 1 Meaningfulness	.282	-.133	.247
Satis 2 Responsibility	.151	-.251	.221
Satis 3 Supervisors	.115	*	.109
Satis 4 Subordinates	.127	*	.122
Satis 5 Growth needs	.254	-.149	.223
Satis 6 Resource utilization	.155	-.168	.161
Satis 7 Existence needs	*	*	*
Satis 8 Obtrusiveness	*	*	*

Relationships among Technology, Job Analysis and Job Satisfaction

Results of the analysis of the items in the technology questionnaire were used to form technology scale scores for each of the respondents in each of the job titles in the NOTAP data set. Each respondent within a job title was assigned a scale score equal to the mean rating of all raters who rated that job title on all items comprising that scale. Thus, for example, an "Automaticity" score for each of the 124 Electrical Motor Rewinders was created by adding the mean scores of the five raters on the two automaticity items.

Each of the scales in the job analysis and job satisfaction section of the NOTAP questionnaire was used as a dependent measure to be predicted in a stepwise regression analysis by the technology measures. The resulting multiple correlations were generally lower than the multiple correlations of the job analysis scales with the job satisfaction scales. This is undoubtedly due in part to the fact that the job analysis scales were based upon incumbents' ratings of their jobs, while the technology scales were based upon expert judges' ratings of job titles. As was mentioned earlier, this can be expected to depress the correlations with measures of experienced job characteristics and overall job satisfaction. In general, one would expect the highest correlations with experienced job characteristics to be produced by incumbents' ratings of their own jobs and somewhat lower correlations from expert judges' ratings of the jobs of incumbents that they had observed directly. The lowest correlations would be produced by expert raters' ratings of job titles (i.e., groups of job incumbents). Thus,

even though the obtained multiple correlations for the technology measures are low, there is reason to believe that these measures, if administered under different conditions, might prove to be more potent predictors of experienced job characteristics and overall job satisfaction.

Only two of the job analysis scales, Strength and Cognitive requirements, had multiple correlations with the technology measures that were statistically significant and approached a reasonable level of practical significance. Three variables entered the prediction equation for Strength, TECH11 (skilled activities), and TECH7 (automaticity) and TECH14 (job identity). Since regression weights for the three variables were approximately equal, an equal weighted composite was formed. The resulting regression weight was .118.

Three variables--TECH5 (Horizontal interdependence), TECH6 (interdependence) and TECH13 (mobility)--entered the regression equation for the prediction of cognitive requirements. Since these three variables also had approximately equal weights in the stepwise regression, an equal weighted composite was fitted to these variables. The common regression weight was .151.

Of the job satisfaction variables, only the three measures of overall job satisfaction could be predicted by the technology measures. Of these measures, Satisfaction with present duty station (Satis 10) had the highest correlations with the technology measures. It was followed by Satisfaction with overall career (Satis 12) and then Overall job satisfaction (Satis 11). This suggests that the technology variables may

be measuring some aspect of the work that is more closely related to job context than to job scope. However, the multiple correlations of the technology measures with the overall satisfaction measures were less than .20.

Because the technology ratings were made on job titles rather than on individual jobs, no attempt will be made here to resolve the question of where the technology measures fit in the path model presented in Figure IV-2. Results from the prediction of satisfaction with present duty station should be interpreted as being suggestive of how the technology measures might be related to overall satisfaction.

A stepwise regression analysis of satisfaction with present duty station, using the technology variables as predictors, selected four variables. Since TECH4 (I/O paths), TECH5 (horizontal interdependence), TECH10 (workspace control) and TECH13 (mobility) received approximately equal weights in the stepwise analysis, an equal weighted regression was specified. The common standardized regression weight for the four variables was .130. Because this is an equal weighted composite, the standardized regression weight is equal to the correlation of the composite with the criterion variable.

VI. DISCUSSION

As indicated earlier, the data presented here can be interpreted within the framework of the Mobley, et al., (1979) turnover model. One result that is consonant with the Mobley model is that overall satisfaction with the job is not the immediate precursor of turnover intention. These data indicate that it is overall career satisfaction that is most directly related to turnover intention. As Mobley and his colleagues note, job satisfaction is present oriented. Overall satisfaction with career, which has a more comprehensive time span, is more similar to what has been called attraction (Mobley, et al., 1979) or commitment (Porter, et al., 1974). Thus, the superiority of overall career satisfaction as a predictor of reenlistment intention is consistent with the Porter et al., (1974) finding that general attitude toward the organization is a better predictor of turnover than are specific attitudes.

Specific attitudes do have an effect upon overall satisfaction with career, but the effects of many of them are mediated by overall job satisfaction or by satisfaction with present duty station. The former variable is more closely related to job scope variables and the latter is affected more by job context scales. Two context scales, resource utilization and existence satisfaction did show evidence of a direct effect on career satisfaction.

As has been found in numerous other studies dating back to Hackman and Lawler (1971), job scope has a substantial effect upon overall job satisfaction. The present result with a sample of active duty military

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personnel extends the work of Katerberg, Hom and Hulin (1979) who found a significant effect of job scope on job satisfaction with National Guardsmen. In light of previous research, it is not surprising that meaningfulness and growth (two measures of job scope) are important predictors of job satisfaction. However, it is interesting that the obtrusiveness of the job, and not responsibility, added significantly to the prediction of job satisfaction--responsibility is generally considered to be an integral part of job scope (Hackman and Oldham, 1976). Obtrusiveness of the job, on the other hand, would be expected to group with the job context scales, which for the most part, were either related to satisfaction with duty station or directly related to satisfaction with career. It is also surprising, given past research, that satisfaction with agents (Satis 3--Supervisors or Satis 4--Subordinates) in the workplace (Locke, 1976) did not emerge as a significant predictor of satisfaction with either the job or the duty station. This result may be due to the nature of the sample. Few jobs in civilian life have the same kind of work context as is found on board ship. In such a work setting, satisfaction with agents could easily be less important than pay, allowances, quarters, or resource utilization as a determinant of satisfaction.

The search for technological predictors of experienced job characteristics could, at best, be termed a limited success. A systematic review of the organizational literature on technology produced a number of items that could be administered at the level of the individual job. Because of constraints on data collection, ratings were

made at the level of job titles rather then individual positions. Factor analyses of technology items produced twelve scales and three unassigned items. The factorial structure of the technology measures was, thus, substantially more complicated than the three factor--knowledge/skill, materials, operations--structure that was derived from the literature. Familiar dimensions such as complexity, uncertainty (Bell, 1967) and routineness (Hage and Aiken, 1969) emerged. Some of the factors such as interdependence and automaticity were clearly indicators of operations technology. Many of the factors associated with either knowledge or materials could not be assigned with any certainty to one component or the other. Indeed, some of the factors were composites of items from both components. This is due in part to a reason already discussed: two different aspects of materials technology (e.g., input standardization and workload variation) may be less highly correlated with each other than with their respective consequences for knowledge or operations.

The ability of the technology scales to predict specific job scope and job context variables was poor. However the statistical significance of their multiple correlations with overall satisfaction with duty station suggests that these technology scales may be capable of tapping reliable variance in career satisfaction that is related to job context. It should also be noted that the multiple correlations of the technology scales were not substantially lower than those of the scales of job analysis variables which were completed by the job incumbents.

Moreover, internal analyses of the technology variables did reveal

that adequate levels of interrater reliability could be obtained for many of the job titles. One would expect that experts' ratings of individual positions (rather than job titles) would produce higher reliabilities. This, in turn, would provide a more satisfactory base of data on which to further refine the technology scales.

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Appendix A

TUKKNIFE: A JACKKNIFE SUPPLEMENT TO CANNED STATISTICAL PACKAGES

The jackknife procedure is a simple and widely applicable technique for computing robust estimates of many statistics and their associated errors. It is of great value for data analysis problems in which there are no readily available techniques for calculating the standard error of a coefficient or when the analyst has reason to believe that conventional estimates of the standard error are inappropriate. The most obvious example of the first situation arises in factor analysis. Pennell (1972) has discussed the utility of the jackknife for this purpose and has strongly recommended its use. Employment of the jackknife in discriminant analysis has been illustrated by Mosteller and Tukey (1969), who emphasize the advantages of direct assessment of coefficient stability provided by the jackknife.

The purposes of this paper are (1) to review the four steps of the jackknife algorithm, particularly in the context of factor analysis; and (2) to describe a computer program, entitled TUKKNIFE, that facilitates the completion of the third and fourth steps of the outlined jackknife algorithm.

The Jackknife Algorithm

The key to the jackknife is the simple device of dividing a body of data into overlapping subsamples. "Pseudovalues" are created by

computing a weighted difference between the coefficients produced by analysis of the entire sample and the coefficients produced by analysis of each of the subsamples. Finally, the mean and standard deviation of the pseudovalues are used to generate estimates of the parameter and its standard error.

The first step of the jackknife requires that the body of data be divided into k subgroups of n observations each. Subsamples are formed by deleting each of the subgroups, in turn, from the body of data. Subsample 1 includes all but the first n observations; subsample 2, all but the next subgroup of n observations, and so on. In step two, the basic analytic procedure (e.g., factor analysis or regression analysis) is performed on the total sample and on each of the k subsamples. In the case of factor analysis, this second step requires a matrix of factor loadings from the analysis of the total sample and from the analysis of each of the k subsamples. In step three these matrices of coefficients are converted to pseudovalues as computed by the following equation:

$$P_i = kF - (k-1)F_i \qquad [1]$$

where P_i is the ith matrix of pseudovalues, k is the number of subgroups, F is the matrix of factor loadings derived from the analysis of the entire body of data, and F_i is the matrix of factor loadings derived from the ith subsample. For regression analysis F and F_i would, of course, be vectors of regression weights.

Step four reduces the obtained pseudovalues to means and standard deviations. The mean of the pseudovalues is an estimate of the

coefficient of interest (i.e., factor loading) and the standard deviation divided by the square root of $\underline{k}$ is an estimate of the standard error of the coefficient.

Since the program is dimensioned for matrix (i.e., $\underline{p}$ x $\underline{q}$) input, the analysis of vector ($\underline{p}$ x $\underline{1}$) input does result in some inefficiencies. Jackknifing of scalar statistics is more appropriately accomplished by the use of Spitzer's (1976) JACKK routine than by TUKKNIFE.

Input

The TUKKNIFE program was designed to supplement canned statistical programs for multivariate analysis such as SPSS. Thus, the program handles only steps three and four of the jackknife algorithm. Steps one and two can be accomplished by SPSS through case selection and procedure calls, respectively. TUKKNIFE requires as input two control cards and a variable number of data cards.

Card 1, which contains the run title or heading, is an 80 character field which can be used to identify the data sets being jackknifed.

Card 2 consists of data definition parameters. The variable in columns 1-5 (right justified) is the number of subsample matrices, $\underline{k}$, from step 1 of the algorithm. In columns 6-10 (right justified) are entered the number of rows (NROW) in each of the matrices which are input to TUKKNIFE. In factor analysis, NROW is the total number of variables. In regression analysis, it is the number of predictors. The next five columns, 11-15 (right justified), are used to provide a means of input for the number of columns (NCOL) in the data matrices. In the case of

factor analysis, NCOL equals the number of factors; for regression analysis, column 15 will contain a "1". Column 20 contains information which indicates whether the input matrices will come from cards ("5") or disk ("7"). Column 25 is used to indicate whether the user wishes to print the input matrices ("1" = YES). Columns 26-30 contain, in F5.3 format, the critical value of the Student $\underline{t}$ statistic appropriate for the 100 $(1-\alpha)$ percent confidence interval for $\underline{k}-1$ degrees of freedom (TCRIT). The last entry on this card is the variable format for the input of the data matrices. The variable format, which may be as long as fifty characters (columns 31-80), must begin with a left parenthesis in column 31 and end with a right parenthesis.

Input data matrices begin with Card 3 and continue through the end of the deck. The major input matrix, based upon the total sample of observations, must be entered first, and may be followed by the subset matrices in any order.

Output

TUKKNIFE will print input data, if desired, as a check. The program always prints a matrix of jackknifed coefficients with an associated half interval in parentheses immediately below the coefficient. The half interval is the numerical evaluation of the expression, $\underline{t}_{\alpha/2}\underline{V}_{ij}/\ \underline{k}$, where $\underline{t}_{\alpha/2}$ is the critical value of the Student $\underline{t}$ distribution, $\underline{V}_{ij}$ is the standard deviation of the pseudovalues, and $\underline{k}$ is the number of subgroups. Thus the jackknifed coefficient plus or minus the half interval is the 100 $(1-\alpha)$ percent confidence interval.

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Commander in Chief
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Officer in Charge
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Naval Air Station Whidbey Island
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LIST 8
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HRM Department (NMPC-6)
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Commanding Officer
Naval Training Equipment Center
Orlando, FL 32813

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ACOS Research and Program
Development
Naval Air Station
Pensacola, FL 32508

Naval War College
Management Department
Newport, RI 02940

LCDR Hardy L. Merritt
Naval Reserve Readiness Command
Region 7 Naval Base
Charleston, SC 29408

Chief of Naval Technical
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NAS Memphis (75)
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Head, Research and Analysis
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Washington, DC 20380

Headquarters, U.S. Marine Corps
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Washington, DC 20380

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National Institute of Education
Educational Equity Grants Program
1200 19th Street, N.W.
Washington, DC 20208

National Institute of Education
ATTN: Dr. Fritz Muhlhauser
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National Institute of Mental Health
Minority Group Mental Health
Programs
Room 7 - 102
5600 Fishers Lane
Rockville, MD 20852

Office of Personnel Management
Organizational Psychology Branch
1900 E Street, N.W.
Washington, DC 20415

Chief, Psychological Research
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ATTN: Mr. Richard Lanterman
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Social and Developmental
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Deputy Chief of Staff for
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LIST 13
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